DOES HEALTHCARE AVAILABILITY IMPACT THE VETERAN SUICIDE RATE?

by
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Abstract

Past research on a recent veteran suicide spike phenomenon has focused on Post-9/11 combat veterans suffering Post-Traumatic Stress Disorder (PTSD) and Traumatic Brain Injury (TBI) from combat in Iraq and Afghanistan. This article presents a different approach by looking at the importance of healthcare accessibility – measured through state uninsured rates – as a possible way to reduce the veteran suicide rate. The Veterans Affairs (VA) only provides healthcare services to honorably discharged veterans, leaving those veterans who received an administrative or punitive military discharge – commonly referred to as "bad paper veterans" – to turn elsewhere for mental health services. This analysis uses VA suicide data covering the 50 states and the District of Columbia from 2011 to 2017 to determine whether post-Affordable Care Act state actions to lower the uninsured rate have impacted veteran suicides. The analysis offers strong support that the uninsured rate explains and influences the veteran suicide rate.

Acknowledgements

I would like to thank the Johns Hopkins University and its staff, particularly Dr. Holly Brasher, for their assistance on this research. I would also like to thank my wife Ciara and the rest of my family for patiently reading various drafts, listening to my presentations, and supporting me throughout my graduate program. I could not have done it without your support.

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1. Introduction

Since 2005, the military veteran suicide rate has increased dramatically compared to the general population suicide rate. The number of veteran suicides has exceeded 6,000 annually from 2008 to 2017, with an average of 17 veterans committing suicide each day.[1] Previous research has focused on age, sex, branch of service, and whether the veteran deployed to a combat zone.[2] The hypothesis at the time was that military veterans were committing suicide at an alarming rate due to the operational tempo of overseas deployments, but recent research has suggested otherwise. Military veterans experience military service in a variety of ways, whether combat veterans or not combat veterans. Research has attempted to better understand why veterans commit suicide, and which veterans are at a higher risk of suicide, but little research exists on different segments of the veteran population.

There is a group of at-risk veterans that may provide additional insights into why the veteran suicide rate has been increasing since 2005: Veterans who are forcibly separated from the military. Military veterans punitively discharged from the military are simultaneously at a higher risk of suicide and likely do not have medical coverage from the Department of Veterans Affairs (the VA). Just like the general population, these at-risk veterans ultimately rely on healthcare services provided through a private employer or public options like Medicare and Medicaid. Unlike their civilian equivalent, this cohort is at a disadvantage since their veteran status comes with either an asterisk or the equivalent of a misdemeanor or felony conviction. By

[1] Department of Veteran Affairs. 2019. "2019 National Veteran Suicide Prevention Annual Report." https://www.mentalhealth.va.gov/docs/data-sheets/2019/2019_National_Veteran_Suicide_Prevention_Annual_Report_508.pdf

[2] Harrell, Margaret, and Nancy Berglass. 2011. "Losing the Battle The Challenge of Military Suicide." http://gspin.org/system/files/filedepot/20/MilitaryUpdate.pdf.

law, a punitive discharge status precludes veterans from receiving any VA benefits, up to and including healthcare.

Amid pressure from the public, Congress has been leaning on the VA to understand and control this crisis, and has recently been granted new statutory abilities by Congress to provide mental healthcare, regardless of discharge status. While the VA is now able to provide limited mental health services to this cohort as of 2018[3], the responsibility of health coverage currently falls on the states. As states choose to expand their Medicaid programs under the Affordable Care Act, their uninsured rates are expected to decrease, providing necessary mental health services to an at-risk and vulnerable group.

This paper will explore and test the hypothesis that a reduction in the uninsured rate corresponds to a reduction in veteran suicide rates. This paper supports the hypothesis that a state's uninsured rate has an appreciable impact on a state's veteran's suicide rate, even when controlling for fixed effects from 2011 to 2017. These results can help support both state and federal policymakers in their efforts to control and reduce the veteran suicide rate. State and federal policymakers can focus on healthcare accessibility for military veterans, whether through their state actions such as Medicaid expansion under the Affordable Care Act or the Veterans Affairs' new efforts to provide healthcare coverage under their new statutory abilities.

[3] McCarthy, Peggy. 2018. "Veterans With 'Bad Paper' Discharges Now Eligible For Mental Health Services." Connecticut Health Investigative Team. March 27, 2018. http://c-hit.org/2018/03/27/veterans-with-bad-paper-discharges-now-eligible-for-mental-health-services/

2. Literature Review and Theoretical Framework

In March 2020, the Washington Post reported on a study conducted by the Legal Services Center (LSC), highlighting how the Department of Veterans Affairs (colloquially referred to as the VA) denied health care to certain types of veterans known as "bad paper discharge" veterans. Perhaps unknown to the general public, the VA only provides health care services to a subset of the veteran population. In Fiscal Year 2014, the Congressional Research Service (CRS) estimated the total veteran population at 21 million, but only 9.1 million veterans were enrolled in VA health care, and 6 million used the VA's health care services.[4]

The VA is charged with providing health care to veterans that meet certain statutory requirements:

1. Meet the definition of a veteran as defined by statute, which is full-time active duty military service;
2. 24 months of continuous service, and;
3. discharge or separation from the military under honorable conditions[5]

Five military discharge categories apply to veterans: Honorable Discharge, General under Honorable Conditions, Other Than Honorable, Bad Conduct Discharge, and Dishonorable. If a veteran is discharged from the military via an Other Than Honorable Discharge, Bad Conduct Discharge or Dishonorable Discharge, these are colloquially referred to as "bad paper discharges." An Other Than Honorable Discharge is an administrative discharge that is not categorized as a criminal offense. A Bad Conduct Discharge is usually – but not always –

[4] Bagalman, Erin. 2014. "The Number of Veterans That Use VA Health Care Services: A Fact Sheet." https://fas.org/sgp/crs/misc/R43579.pdf.
[5] Moulta-Ali, Umar, and Sidath Viranga Panangala. 2015. "Veterans' Benefits: The Impact of Military Discharges on Basic Eligibility." https://fas.org/sgp/crs/misc/R43928.pdf.

categorized as a misdemeanor, where a dishonorable discharge is regarded as a felony charge. The bad paper discharge group has previously represented less than two percent of the veteran population as far back as the World War II era, however, the Post-2001 era – defined as those who served from 2002 to 2013 – now represent approximately six percent of the veteran population.[6] From World War II to present, more than 2.3 million veterans received a less than fully honorable discharge.[7]

While a small amount of the total veteran population, this group receives a serious penalty for their actions post-military service. Veterans who receive a bad paper discharge cannot receive services and benefits from the VA, regardless of the veteran's mental and physical condition. There is one exception: veterans who received an Other Than Honorable Discharge can appeal to the VA, but until their appeal has been heard and granted, the veteran cannot receive any benefits. The appeal option is not available for the other two punitive discharges that make up the bad paper discharge category, such as bad conduct and dishonorable. It is also infrequently that the state definition of veteran differs from the VA standard, further reducing the likelihood that a veteran with a bad paper discharge will receive benefits at the state level.

Since bad paper veterans cannot receive care from the VA, the onus falls on the states and private employers for insurance coverage. The Affordable Care Act was passed into law in 2010, allowing for states to expand their Medicaid coverage to previously underinsured and uninsured citizens. Since then, there have been numerous studies that researched the effects of Medicaid expansion in those states that elected to do so. A 2019 study that summarizes the

[6] Veterans Legal Clinic. 2016. "Underserved - How the VA Wrongfully Excludes Veterans with Bad Paper." March 2016. https://www.swords-to-plowshares.org/wp-content/uploads/Underserved.pdf.
[7] Ibid.

findings of over 300 studies highlighted two key findings relevant to the bad paper discharge cohort: 1) Medicaid expansion states saw a noticeable reduction in uninsured rates of vulnerable populations, and 2) Medicaid expansion states saw improvements in access to medications and mental health services[8]. States are also taking action to address this veteran group, both directly and indirectly. States like Connecticut expanded their definition of veteran service to include bad paper discharge veterans, in an effort to provide basic medical and financial services at the state level while other programs like VA health care and benefits catch up.[9]

This subgroup of the military veteran population, with a likely higher suicide risk and unique needs, is not adequately being represented in research or public policy discussions. For example, a study was done in 2014 that solely relied on VA medical records to create predictive models on veteran suicide risk[10]. The limitation with research done to date is that most studies solely analyze active duty military or veterans that are being served by a VA Medical Center. While this research is helpful to those veterans that use VA services, it leaves out veterans who elect not to use VA health services, and those who cannot use VA health services, such as bad paper discharge veterans.

A 2016 study of military veterans by Becerra et. al. arguably made the first connection between an unmet mental healthcare need and suicidal ideation and first addressed the gap in the

[8] Guth, Madeline et. al,. 2020. "The Effects of Medicaid Expansion under the ACA: Updated Findings from a Literature Review." The Henry J. Kaiser Family Foundation. March 17, 2020. https://www.kff.org/medicaid/issue-brief/the-effects-of-medicaid-expansion-under-the-aca-updated-findings-from-a-literature-review-august-2019.
[9] Lawrence, Quil. 2018. "NPR Choice Page." Npr.Org. 2018. https://www.npr.org/2018/11/26/668358128/connecticut-va-opens-its-doors-to-bad-paper-veterans.
[10] Thompson, Paul, Chris Poulin, and Craig Bryan. 2014. "Workshop on Computational Linguistics and Clinical Psychology: From Linguistic Signal to Clinical Reality, Pages 1-6, Predicting Military and Veteran Suicide Risk: Cultural Aspects." https://www.aclweb.org/anthology/W14-3201.pdf.

literature at the time. This study used a logistic regression model to conclude that unmet mental healthcare need was associated with four times the likelihood of suicidal ideation for the military veteran population.[11] Research done by Waszak and Holmes in 2017 on the unique health needs of Post-9/11 veterans also noted the limitation of solely focusing on veterans that use VA healthcare services. Their research recognized the limitations of previous research that omitted non-VA healthcare veterans, since a sizeable portion of the veteran community does not receive healthcare from the VA.[12]

One study done by Elbogen in 2018 attempted to address the stated research limitations by intentionally selecting a sample of veterans that includes those with an Other Than Honorable discharge from the military. This study found that veterans with Other Than Honorable discharges were more likely to have a major depressive disorder, have a history of drug abuse and depression, and a lower level of social support.[13] Elbogen's research notes that the cohort of bad paper discharge veterans differs from the general veteran population, and that identifying information unique to this cohort would be valuable when informing new VA policies and when developing care options. While this research did not include those veterans that received a Bad Conduct Discharge or Dishonorable Discharge, that research is the most recent to identify a difference between the bad paper veterans' group and the general veteran population.

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[11] Becerra, Monideepa B., Benjamin J. Becerra, Christina M. Hassija, and Nasia Safdar. 2016. "Unmet Mental Healthcare Need and Suicidal Ideation Among U.S. Veterans." American Journal of Preventive Medicine 51 (1): 90–94. https://doi.org/10.1016/j.amepre.2016.01.015.

[12] Daria L. Waszak and Aline M. Holmes, "The Unique Health Needs of Post-9/11 U.S. Veterans," Workplace Health & Safety 65, no. 9 (August 29, 2017): 430–44, https://doi.org/10.1177/2165079916682524.

[13] Elbogen, Eric B., H. Ryan Wagner, Mira Brancu, Nathan A. Kimbrel, Jennifer C. Naylor, Cindy M. Swinkels, and John A. Fairbank. 2018. "Psychosocial Risk Factors and Other Than Honorable Military Discharge: Providing Healthcare to Previously Ineligible Veterans." Military Medicine 183 (9–10): e532–e538. https://doi.org/10.1093/milmed/usx128.

In 2017, the Government Accountability Office (GAO) published a report that made a connection between punitive separations and mental health issues. From 2011 to 2015, the GAO noted that 62% of veterans separated for misconduct had been diagnosed within the previous two years before their separation for PTSD or TBI, and approximately two-thirds had not deployed within the two years prior to their separation.[14] Further, 23% of the veterans during this time period received a bad paper discharge, barring them from VA services.[15] In response to the GAO report, the VA expanded mental health services to bad paper discharge veterans in 2018. As a result of the GAO's findings, the VA has now closed the gap and made its mental health services available to all veterans, regardless of their discharge status.[16]

3. Data and Methods

The datasets used were the 2005-2017 Department of Veterans Affairs (VA) Veteran Suicide report, officially known as the VA 2005 - 2017 National State Data Appendix[17]. This report contains information on veteran suicide rates (per 100,000 people) by state and by year, and the corresponding general population suicide rate for the same state and time period. The dataset also includes veteran suicide rates by age group, sex, and method of suicide such as the use of a firearm, hanging, or drowning. After further review of the data, there were some limitations with some of the data subsets – specifically the breakouts by sex and method of

[14] U.S. Government Accountability Office. 2017. "DOD Health: Actions Needed to Ensure Post-Traumatic Stress Disorder and Traumatic Brain Injury Are Considered in Misconduct Separations." Gao.Gov, no. GAO-17-260. https://www.gao.gov/products/GAO-17-260.
[15] Ibid.
[16] McCarthy, Peggy. 2018. "Veterans With 'Bad Paper' Discharges Now Eligible For Mental Health Services." Connecticut Health Investigative Team. March 27, 2018. http://c-hit.org/2018/03/27/veterans-with-bad-paper-discharges-now-eligible-for-mental-health-services/.
[17] Department of Veterans Affairs, "Veteran Suicide Data - Mental Health," Va.gov, 2014, https://www.mentalhealth.va.gov/mentalhealth/suicide_prevention/data.asp.

suicide - that hindered thorough data exploration and analysis. The subset data (with the exception of the subset by age group) was removed from further analysis.

In addition to the VA Veteran Suicide Report, the US Census Bureau's American Community Survey (ACS) survey was used to collect healthcare-related data for analysis. The survey titled "Number and Percentage of People Without Health Insurance Coverage by State"[18] was used to collect whether a state was a Medicaid expansion state, the uninsured rates, and reported VA enrollment rates. The status of state Medicaid expansion in the ACS dataset was verified against data from the Kaiser Family Foundation, a not-for-profit organization focused on health policy analysis and health journalism.[19] Table 1 shows which states adopted and implemented Medicaid expansion from 2014 to 2020. The population and GDP by year for each state were pulled from the Bureau of Economic Analysis (BEA) Data Tools.[20]

The dependent variable is the state's veteran suicide rate per 100,000 people. The Bureau of Economic Analysis and American Community Survey data was used to enrich the VA dataset. There are 357 observations of states from 2011 to 2017[21]. The timeframe used was 2011 to 2017 for the 50 states and the District of Columbia.

VA suicide data before 2011 was incomplete and proved to be unreliable for analysis. Using VA suicide data before 2011 may have created an unbalanced panel in further analysis. As a result, it was removed from further analysis. Furthermore, U.S. territories were also removed

[18] Prior to September 2014, these tables were listed under the Current Population Survey.
[19] The Henry J. Kaiser Family Foundation. 2020. "Status of State Action on the Medicaid Expansion Decision." The Henry J. Kaiser Family Foundation. January 10, 2020. https://www.kff.org/health-reform/state-indicator/state-activity-around-expanding-medicaid-under-the-affordable-care-act/?currentTimeframe=0&sortModel=%7B%22colId%22:%22Location%22.
[20] https://www.bea.gov/tools/
[21] n = 51 for 50 states and the District of Columbia; t = 7 for the three years before the 2014 Medicaid expansion (2011-2013) and three years after (2014-2017).

from analysis due to insufficient and incomplete veteran suicide data and uninsured data from 2011 to 2017. Multiple imputation was used to replace a minuscule amount of remaining missing data in an effort to reduce bias from missing observations and create a balanced panel.

After data cleaning and multiple imputation in Stata[22], the data was sufficient for conversion to panel data, allowing for fixed effects multivariate regression analysis. This method of analysis helps to control for time and entity effects and determine if the independent variables in question statistically impact the veteran suicide rate. In addition to fixed effects multivariate regression, a comparison of means was also used to confirm a difference in the suicide rates between the veteran population and the general population. Table 2 highlights the mean, standard deviation, minimum, and maximum of these key variables.

[22] Stata is a statistical software package that was used for this analysis

Table 1– 50 States and the District of Columbia by Adoption Status and Adoption Year

Adopted Medicaid Expansion					Not Adopted
2014	**2015**	**2016**	**2017**	**2018-2020**	
Arizona	Alaska	Louisiana		Maine (2019)	Alabama
Arkansas	Indiana	Montana		Virginia (2019)	Florida
California	Pennsylvania			Idaho (2020)	Georgia
Colorado				Utah (2020)	Kansas
Connecticut					Mississippi
Delaware					Missouri
District of Columbia					Nebraska
Hawaii					North Carolina
Illinois					Oklahoma
Iowa					South Carolina
Kentucky					South Dakota
Maryland					Tennessee
Massachusetts					Texas
Michigan					Wisconsin
Minnesota					Wyoming
Nevada					
New Hampshire					
New Jersey					
New Mexico					
New York					
North Dakota					
Ohio					
Oregon					
Rhode Island					
Vermont					
Washington					
West Virginia					

Source: The Henry J. Kaiser Family Foundation

Table 2 – Descriptive Statistics of Dependent Variables

Dependent Variables	Mean	Standard Deviation	Minimum	Maximum
All Ages				
Veteran Suicide Rate	32.15	9.51	9.6	62.8
General Population Rate	20.05	5.72	5.8	36.9
Ages 18-34				
Veteran Suicide Rate	45.94	14.16	21.9	85.7
General Population Rate	19.54	7.20	8.1	50.6
Ages 35-54				
Veteran Suicide Rate	32.94	12.82	8.1	73.7
General Population Rate	22.23	6.35	9.6	40.8
Ages 55-74				
Veteran Suicide Rate	28.96	9.94	12.4	68.4
General Population Rate	18.99	4.65	10.1	32.7
Ages 75+				
Veteran Suicide Rate	32.65	15.07	9.7	137.5
General Population Rate	20.68	8.29	7.2	63.7
Other Variables				
Uninsured Rate	8.84	3.36	2.5	19.1
VA Rate Percent	2.567	.6831	1	4.4
GDP Per Capita	$54,113	$19,586	$33,479	$174,343
Veteran Population Percentage	6.87	1.25	3.96	9.29

Source: VA 2005 - 2017 National State Data Appendix, the American Community Survey (ACS), and the Bureau of Economic Analysis

4. Key Findings

Research has shown an association between mental health care availability and a reduction in suicide[23]. Previous research primarily focused on active-duty servicemembers and veterans who served in Post-9/11 combat and attempted to understand why the rate of suicide for those groups increased. Studies have also focused on the Department of Veterans Affairs itself. This paper takes a different approach and looks at the importance of healthcare accessibility - measured through a state's uninsured rate - as a possible link to reduce the veteran suicide rate. It examines the 50 states and the District of Columbia from 2011 to 2017, and how their actions relating to the state uninsured rate have impacted their state's veteran suicide rate.

Focusing on state actions and healthcare accessibility is important to understanding the current crisis. Not all veterans use VA medical services, whether by personal choice (better health insurance is offered through an employer or public option such as Medicaid or Medicare) or because they are not eligible. Until recently, bad paper veterans were not qualified to use VA mental health services, regardless of the veteran's need. This puts additional pressure on states to find solutions to a nationwide crisis. States are making critical decisions to expand Medicaid enrollment, and in some cases, provide targeted care to at-risk veterans without access to mental health services.

This analysis found that a reduction in a state's uninsured rate is related to a reduction in veteran suicide. Analysis of state-level veteran suicide rate data from 2014 to 2017 consisted of a comparison of means, decision tree and random forest classification methods, and fixed effects

[23] Rand Corporation. 2018. "The Relationship Between Mental Health Care Access and Suicide." http://www.Rand.Org. 2018. http://www.rand.org/research/gun-policy/analysis/essays/mental-health-access-and-suicide.html.

multivariate regression. This analysis validated information found during the literature review and revealed new insights for further analysis and discussion.[24]

4.1 Selection of Key Candidate Variables to Explain the Veteran Suicide Rate

The initial analysis started with supervised machine learning using decision trees and random forests. A decision tree is a type of classification method to determine which variables best explain the variable in question. In other words, what factors influence a state's veteran suicide rate? For this analysis, a decision tree was used to isolate variables of significance for further analysis and testing. Several decision tree iterations were run using R Studio, an open-source software. A random forest classification method was used to run 500 un-pruned decision trees to reduce any bias from any single decision tree. Appendix A includes one of the decision tree outputs and the random forest output. The random forest method identified variables such as the state's uninsured rate, the general population suicide rate, whether the state expanded its Medicaid program as a result of the ACA, the VA enrollment rate, veteran population percentage, and the state's GDP per capita as important predictors. These variables were used throughout the analysis.

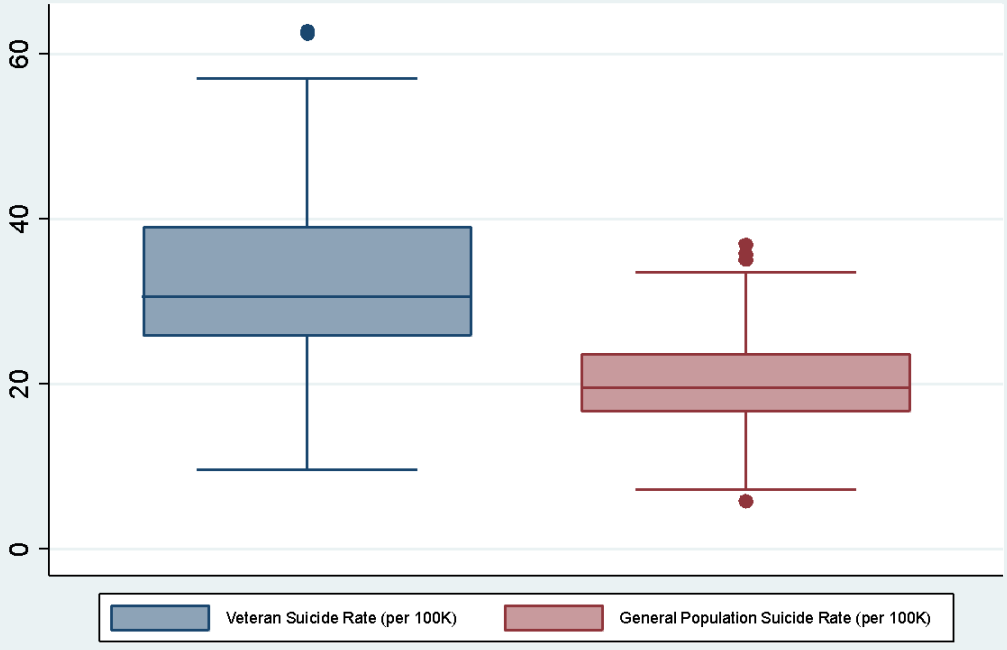
4.2 Comparison of Veteran Suicide Rate to the General Population

At the state level and the national level, the veteran suicide rate is noticeably higher compared to the general population suicide rate, even in states that expanded their Medicaid programs in 2014 and beyond. This is consistent with existing research on the subject. Figure 1 illustrates the difference in suicide rates between the two groups from 2011 to 2017. Not only is the average veteran suicide rate higher than the general population's, but there are also states

[24] Multiple imputation was applied to variables that were missing observations from the original data set.

with several outliers in the 50 and 60 suicides per 100,000 range. Contrast that with the general population in the same timeframe, with state outliers that do not exceed 40 suicides per 100,000.

Figure 1 - Veteran Suicide Rate and General Population Suicide Rate (2011-2017)

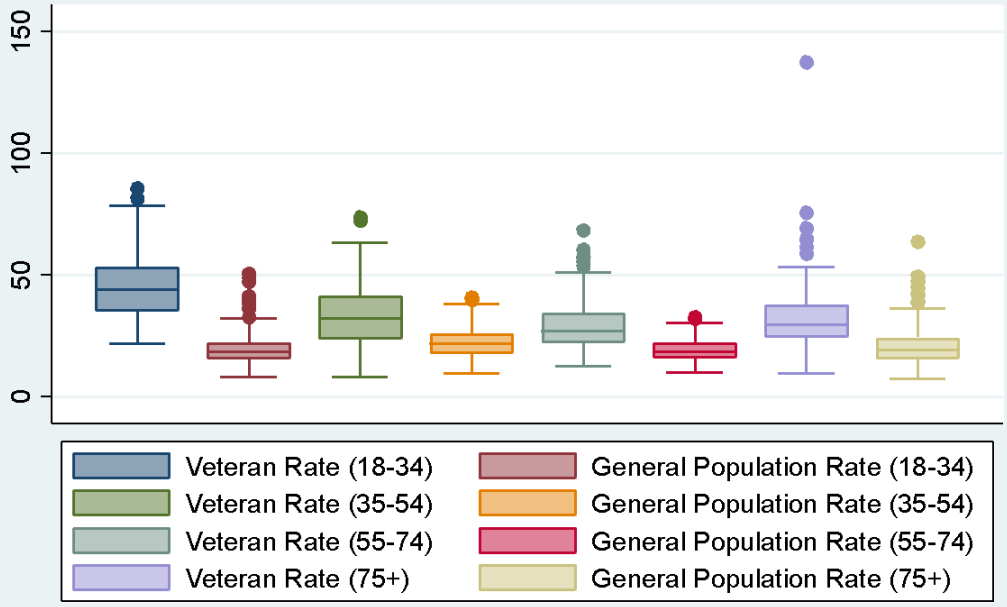


Source: VA 2005–2017 National Suicide Data Appendix

Bad paper veterans do not belong to one age group, so it is important to look at all age groups to see if differences by age cohort exist. When dividing the veteran and general population groups into age cohorts - as shown in Figure 2 - it is apparent that there are noticeable differences between the veteran and general population groups, and the age groups themselves. For example, the youngest veteran cohort (18-34) has the largest gap between the veteran suicide rate (42.9 per 100,000) and the general population rate (18.55 per 100,000). Existing research has typically focused on the 18-34 cohort, ostensibly for two reasons: First, it is the age group with the highest rate of suicide compared to other age groups. Second, it is mostly made up of Post 9/11-era veterans, typically associated with Post-Traumatic Stress Disorder (PTSD) and Traumatic Brain Injuries (TBI) from their tours in Iraq and Afghanistan. Another noteworthy

observation is that all age groups, even those 75 and over, have a higher suicide rate than their non-veteran counterpart. This observation runs contrary to some – but not all – of the existing research on this subject, and suggests that the current Post-9/11-era conflicts were not the only significant driver of the veteran suicide rate increase.

Figure 2 - Veteran Suicide Rate and General Population Suicide Rate By Age Group (2011-2017)

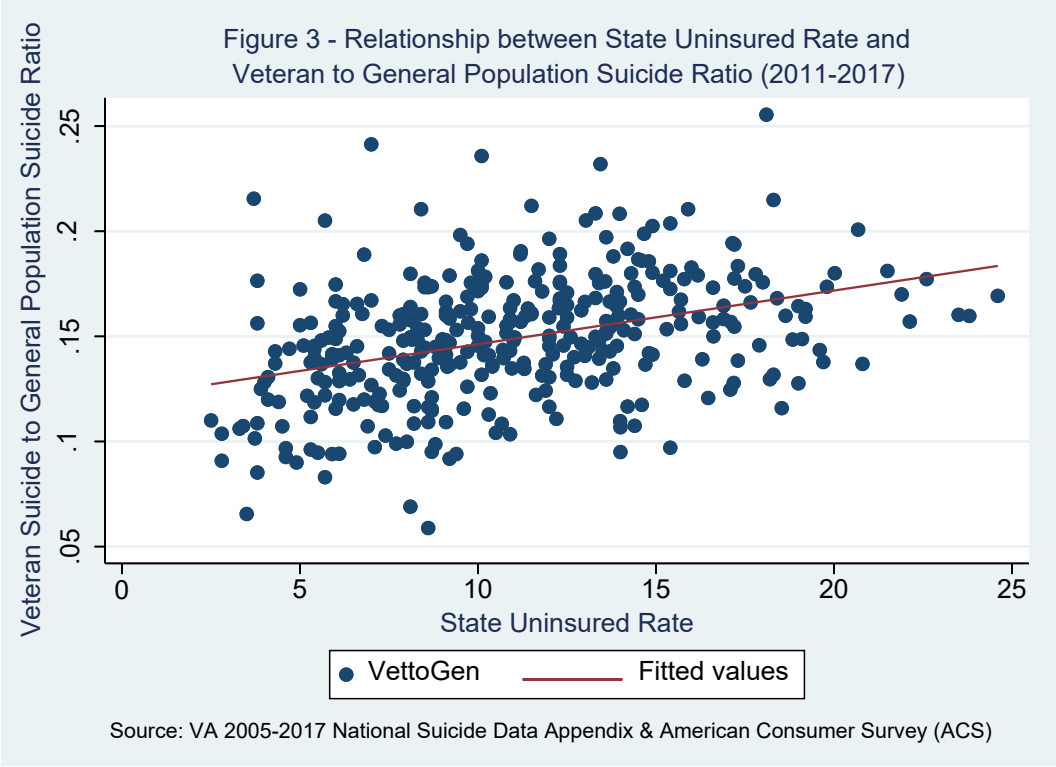


Source: VA 2005-2017 National Suicide Data Appendix

4.3 The Relationship of Veteran Suicide Rate to the State Uninsured Rate

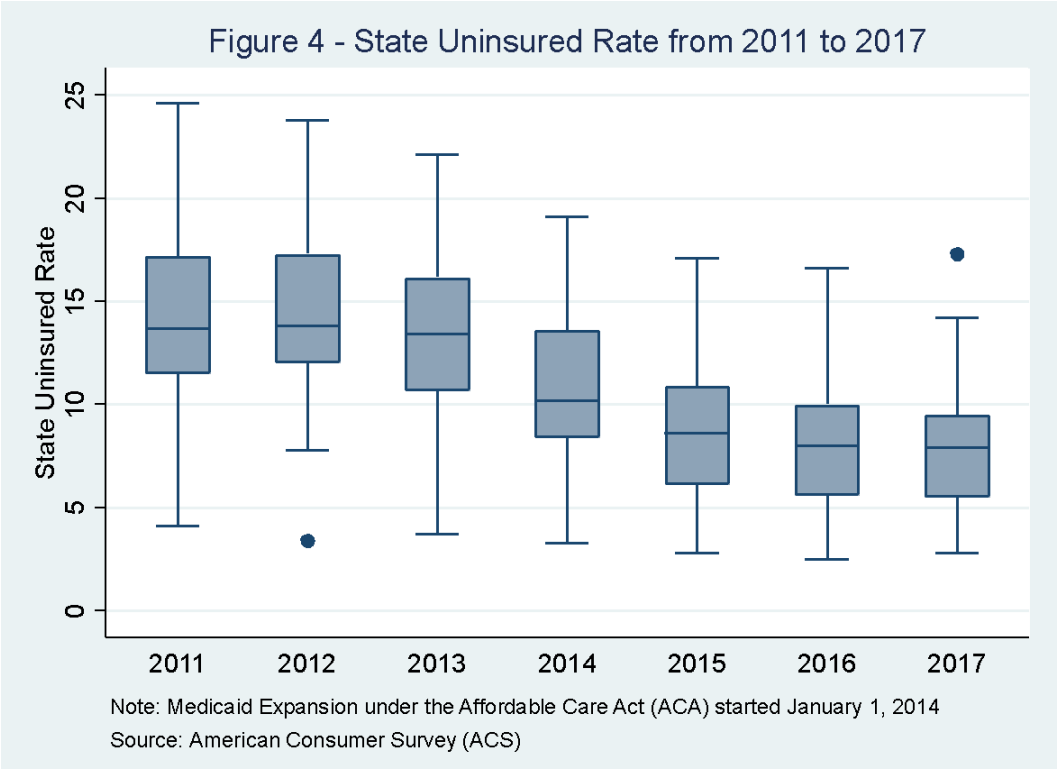
While the Affordable Care Act (ACA) does not require mental health services as mandatory health benefits, the ACA does provide a way for states to provide health coverage for the previously underserved. This is especially important for bad paper veterans with little to no access to VA health care services. Figure 3 shows a possible positive correlation (r = .305) between the veteran suicide rate and the uninsured rate. As a state's uninsured rate increases, the veteran suicide rate increases as well. There is also a similar – yet weaker - positive correlation between the state's VA enrollment rate and the state's uninsured rate. Future research is needed

to determine the root cause of this potential relationship. The correlation between VA enrollment rate and a state's uninsured rate may hint at a deeper issue that is outside the scope of this paper: healthcare quality as a subcomponent of healthcare accessibility.



There was a reduction in the uninsured rate from 2011 to 2017, most notably after the 2014 expansion of Medicaid completed by the first wave of states. Other states followed suit from 2015 to 2017, bringing the total in 2019 to 36 states and the District of Columbia. Figure 4 visualizes the change in the mean state uninsured rate and the minimum and maximum state uninsured rates. 2011 saw an average state uninsured rate of 14.05%, with uninsured rates as high as 24.6%. When states started to expand under the ACA, the state uninsured rate was approximately 10.68%, with the uninsured rates as high as 19%. Since states started focusing on providing health coverage to their citizens, the uninsured rate has dropped to an average of 8.07% with a high of 17.3%.

A reduction in state uninsured rates will presumably lead to increased access to mental health services to veterans and the general population alike. Since bad paper discharge veterans were not legally able to use VA mental health services until recently, the onus fell on that group to obtain employer-provided health insurance or rely on public options such as Medicaid, Medicare, and the Federal marketplace. Even veterans with an honorable discharge that did not enroll in VA healthcare still benefit from additional access to mental health services.



4.4 Determining Statistical Significance between Uninsured Rate and Veteran Suicide Rate

Using a regression model helps identify if there is a statistical relationship between the uninsured rate and the veteran suicide rate. Model 1 uses fixed-effects panel regression to control for changes over time and individual changes made by each state that are not captured in the model, such as state-specific mental health programs and suicide prevention and outreach

programs[25]. The results of Model 1 – shown below in Table 3 – show a negative relationship between a state's uninsured rate and the veteran suicide rate, even when controlling for a state's GDP per capita and the general population's suicide rate.

Table 3 - Regression Model Results: State Veteran Suicide Rate from 2011 to 2017 (All Ages)

	Model 1
Uninsured Rate	-.1903*
	(.1001)
GDP Per Capita	-.0004*
	(.0002)
General Population Suicide Rate	1.2499*
	(.1690)
Constant	29.1128*
	(9.6027)
F-statistic	29.50
Fixed Effects	Yes

Notes: The outcome variable is "military veteran suicide rate per 100,000 people"

*p < .05

[25] Model 1 was created using Stata

4.5 Examining Effects on Veteran Suicide Rate

For the time period examined (2011 to 2017), there appears to be a statistically valid interaction between the state uninsured rate and the state veteran suicide rate.[26] As the uninsured rate decreases by 1 percent, the veteran suicide rate decreases by .19 per 100,000 people. In terms of real-world significance, this is noteworthy. In a state the size of Maryland (with approximately 6 million residents as of 2020), a reduction of one percent in the uninsured rate would equate to 11 veterans per year not falling to suicide.

This finding is important but it does come with a caveat. The decrease in the veteran suicide rate appears to be statistically significant, and while any decrease in the suicide rate is welcome and ultimately saves lives, the strength of the decrease was not as strong as originally hypothesized. One possible justification is that there is a significant time lag from a change in the state's uninsured rate to the impact on the veteran suicide rate, which will have to be reviewed in future research.

While the state uninsured rate was statistically significant, the general population suicide rate and GDP per capita were statistically significant as well. An increase in GDP per capita also has an impact on the veteran suicide rate. A $1,000 increase in GDP per capita corresponds to a predicted decrease in the veteran suicide rate by 0.4 per 100,000 people. The model also revealed the general population suicide rate as the most significant factor. A decrease in the general population suicide rate has the largest impact on the veteran suicide rate. As the general population suicide rate decreases by 1 per 100,000 people, the veteran suicide rate decreases by 1.25 per 100,000 people. This is remarkable because it hints at the possibility that the factors

[26] Significance of alpha = 0.10

driving the general population suicide rate are also driving the veteran suicide rate. Further research is needed to validate if and how the two groups are inherently linked.

5. Conclusion

Military veterans are committing suicide at an alarming rate, and efforts to understand and reduce this phenomenon have not achieved the intended effect. Previous research focused on the cause of suicide and the conditions surrounding a veteran's individual behavior and characteristics, such as age, sex, branch of service, and whether the veteran served in combat. This paper's approach builds on that research by pivoting in a new direction: Does healthcare access – measured through a state's uninsured rate – play a role in a state's veteran suicide rate? This paper presents strong evidence of that being the case, even when controlling for factors such as GDP per capita and time effects from 2011 to 2017.

There are limitations in this paper that are worth noting, some of which can be addressed in future research. The time period examined (2011 to 2017) was a pivotal period in the implementation of the Affordable Care Act Medicaid expansion. Since some states only recently expanded under Medicaid as recently as 2020, more data – and therefore time – is needed for sufficient observation of laggard states. While the VA publishes a comprehensive public dataset for analysis, the VA also has an approximately two-year time lag when publishing data on veteran suicide. Another limitation is the data from U.S. territories, which was insufficient for analysis at this time. While only a small percentage of the total veteran population, having data from U.S. territories would increase the rigor of the analysis completed. Future research can also address some interesting findings that were outside the scope of the paper. This paper focused on healthcare accessibility, however a correlation between the VA enrollment rate and other

variables such as the veteran suicide rate and uninsured rate hint at another topic: healthcare quality and its impact on the veteran suicide rate.

The Veterans Affairs is under constant pressure from the public and from Congress to find ways to reduce the veteran suicide rate. This paper provides new research for the VA and state policymakers to shift their focus to making healthcare accessible in an effort to reduce the veteran suicide rate.

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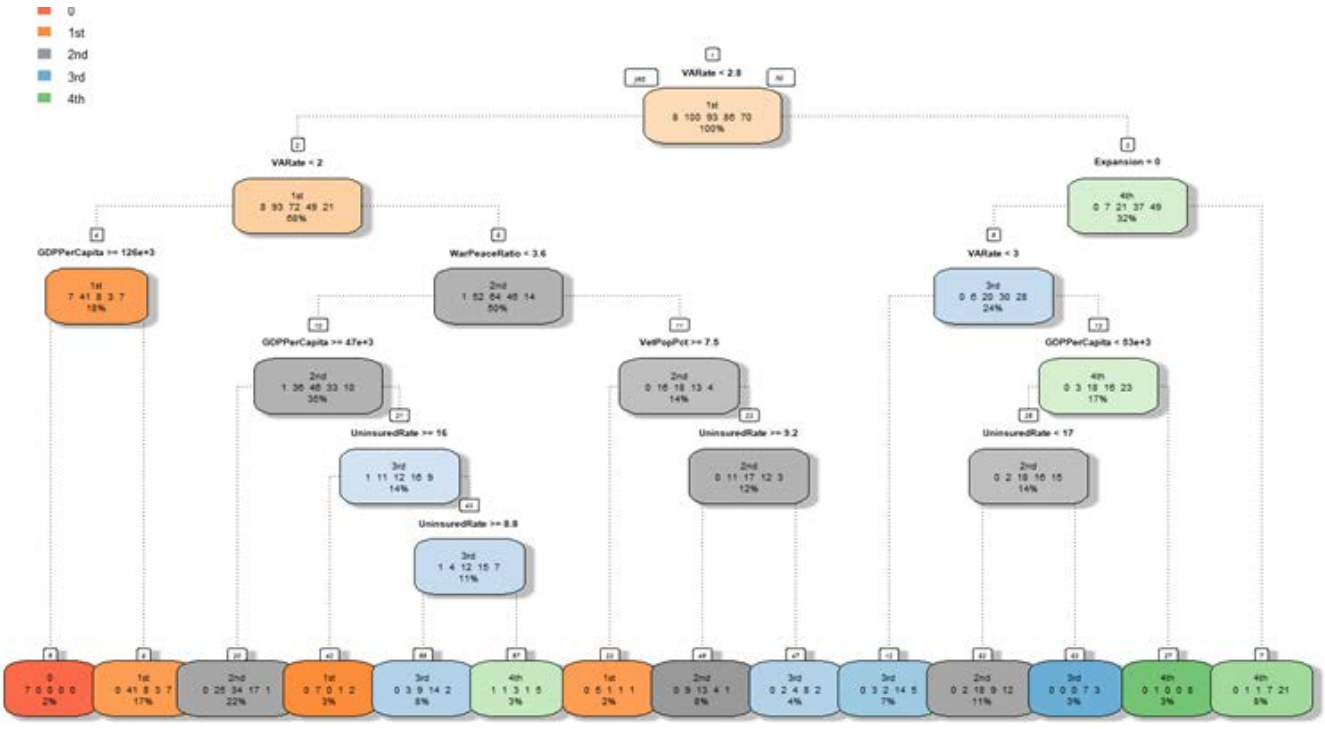
Appendix A

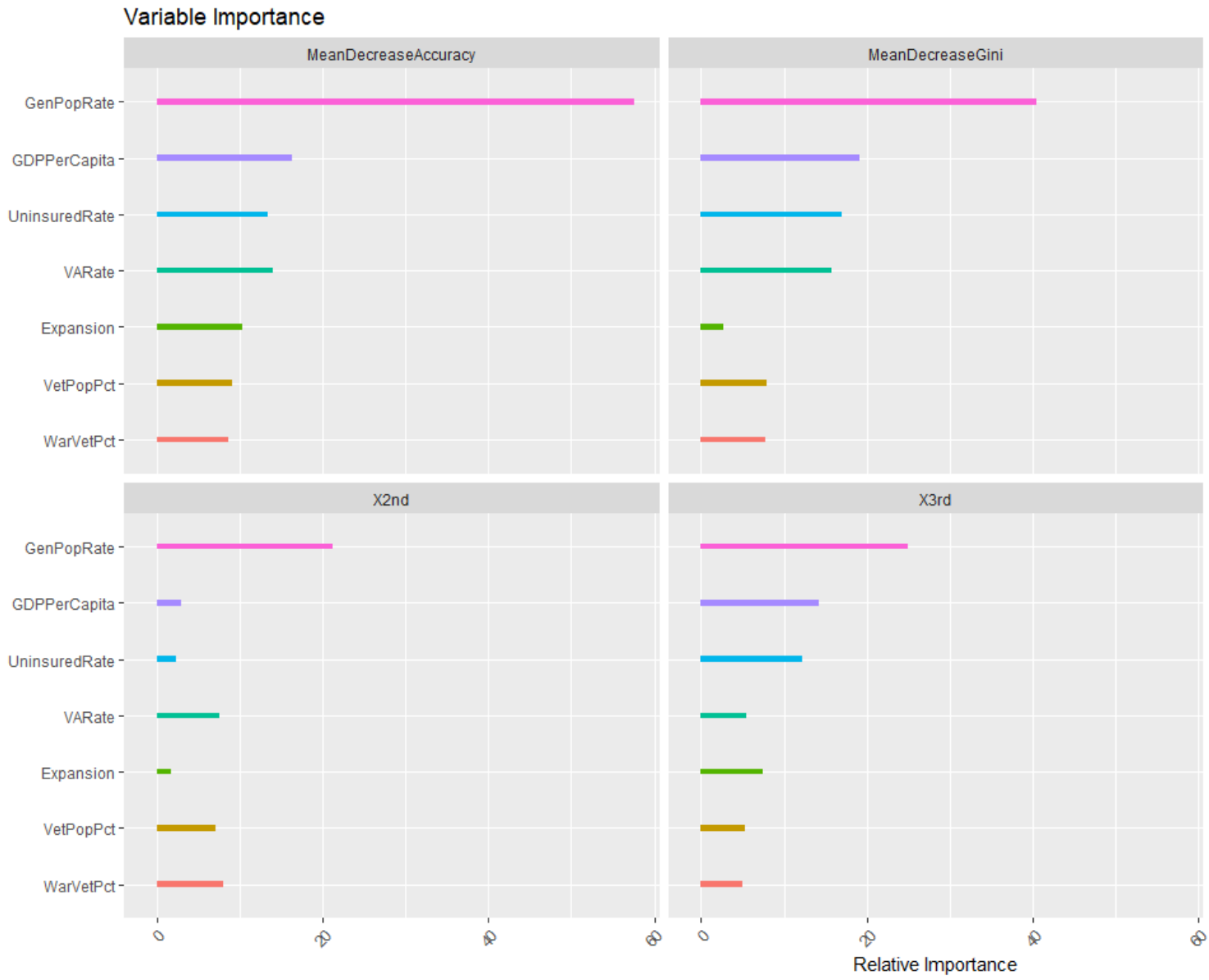
A decision tree is a supervised machine learning method that uses simple decision rules to predict the value of a target variable.[27] Decision trees are useful to determine which variables may be statistically significant. A random forest is an assembly of multiple un-pruned decision trees. Running a random forest helps reduce potential bias and uncertainty with a single decision tree output. Figure 1 shows a decision tree output from R Studio, a statistical and programming software, and Figure 2 shows the output of a random forest consisting of 500 decision trees and the relative importance of each variable, also generated using R Studio.

Figure A1 – Decision Tree



[27] "1.10. Decision Trees — Scikit-Learn 0.22 Documentation." *Scikit-Learn.Org*, 2009, scikit learn.org/stable/modules/tree.html.

Figure A2 – Random Forest Output



Curriculum Vitae

Fredy Diaz was born in East Meadow, New York in 1985. He served nine years in the United States Marine Corps, deploying to both Iraq and Afghanistan in support of Operation Iraqi Freedom and Operation Enduring Freedom. Since transitioning to civilian life, he started his career in the federal government and earned his Master in Business Administration (MBA) from the University of Baltimore in 2016. He currently works at the Postal Service Office of the Inspector General (OIG). He is a degree candidate with the Johns Hopkins University and submitted this research in fulfillment of the Master of Science in Government Analytics with a concentration in Public Management.